PATENT APPLICATION INFORMATION

LED Powered Airfield Surface Location System
-or-
LED Powered Airfield Surface Movement Locator
-or-
Surface Movement Guidance Control System

Inventor:
The system design concept is that of Douglas E. Woehler.

Discussed and described to Comteq, Inc. President Gary B. Woehler on October 26, 2000.

Design Concept:
Due to the fact that LED's have no thermal inertia as filament type lamps have, they can be turned on and off in microseconds. This ability now allows the light emitted from them to be encoded with a serial type signal. This is the basis for this invention. Lasers, microwaves and other similar devices possess this ability also, but they are not visible and are not able to be applied to airfield lighting meeting FAA visibility requirements.

ABSTRACT

The power supply for a LED powered edge light is connected to the usual 6.6A loop via the appropriate series transformer on the airfield. This power supply provides the DC voltage sufficient to power the LED light array in the fixture. Between the DC power supply and the LED array, a switching transistor is installed. This switching transistor is used to turn the LED array on and off. A programmable signal processor operates the switch in each LED powered airfield visual guidance marker. An external programmer provides a means of setting a location code in the signal processor. Each LED fixture is given a discrete code, via the programmer, that is peculiar to that fixture. No other fixture on the airfield, unless it is desirable to have two or three the same in one area, has that code. The signal processor output is a serial data stream that always provides a 50% duty cycle (using the Manchester coding scheme) to the LED power switch, no matter what the code. This coding scheme allows any code setting to be programmed into the processor, and it does not change the apparent brightness of the LED array. This block of location data is sent continually to the LED switch. This "on-off" switching occurs at a speed well above the eye's ability to see the "flashing" of the LED. Typically, the eye can detect a flash rate below about 16 Hz. Movies and television use a refresh rate above this rate, typically 24 to 30 Hz. The flash rate of the LED is typically many times above the ability to see any flashing. A rate of switching is used to provide a baud rate sufficient to transmit the code data continuously, many times per second. Each LED fixture so equipped is programmed with its location code (typically a 5-digit number) and its location is noted on the airfield lighting maps.

A receiving "Pod", containing a sensor and a signal-processing receiver, is mounted on the lower front of any aircraft or vehicle using the airfields that have the system installed. The sensor in the pod detects any light within a typically 270-degree radius in front and to either side of the aircraft (or vehicle) out on the airfield. The location code is read via the light pulses transmitted by any LED equipped fixture nearby. The signal processor sorts out the signals and decides what the location code is. Once the processor determines the location code, it then adds the flight number and the tail number to the location data. The flight number is always available (as it is always changing) from the planes computer in real time, as a read only signal. The tail number is hard coded into the Pods processor. The data is assembled into a new block of data containing all of the three items, and is then transmitted as a single block of data via a wireless communications channel to the Air Traffic Control Tower Surface Movement Guidance & Control System (SMGCS) computer.

Once the data block is in the SMGGS computer, it is displayed on a screen used by the ATC's. This display shows the location of every moving object on the airfield. The lighting control system computer uses the data to control guide lights for the plane to follow to the gate or the runway. The SMGCS computer also keeps track of each planes location to prevent incursions and collisions.

BACKGROUND OF THE INVENTION

Although the patent literature and the marketplace afford many types of communications equipment capable of transmitting signals as to where an object is (GPS, Radar, etc.) there is nothing more adapted to, and obvious as, using existing lamp locations as markers. These markers are already placed as close to the aircraft as is reasonably possible, they have a power source, and are accepted and required on every airfield commercial and military aircraft use. Using these proximity markers, this system has a better location accuracy, typically 50' (½ the spacing distance of the fixtures, usually 100'), than any other system fielded to date.

STATEMENT OF THE INVENTION

It is therefore an object of the invention to provide a digital communication link between the numerous and proximal edge light fixtures and/or any other fixtures that may be proximal to the aircraft, and useful in providing a source of data, providing a fixed location of the aircraft.

It is another object of the invention to provide a digital communication link for transmitting this data to the aircraft continually and accurately.

It is another object of the invention to provide a digital communication link for a means of loading the location code numbers into the data transmitter.

It is another object of the invention to provide a digital communication link that does not affect the light output of the illuminator when different codes are transmitted

It is another object of the invention to provide a digital communication link that provides a most advantageous cost to benefit ratio owing to the relatively low acquisition cost and maintenance costs and the high degree of reliability of the installation.

It is another object of the invention to provide a digital communication link that...........

It is another object of the invention to provide a digital communication link that...........

It is another object of the invention to provide a digital communication link, which is versatile in that it is capable of being readily adaptable to numerous different environments.

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SHORT DESCRIPTION OF THE DRAWINGS:

Fig. 1 is a simplified diagrammatic layout of a digital communication system constructed pursuant to the invention, the system shown here being especially adapted for use on an airfield to provide continuous location of all aircraft and vehicles on an airfield.

Fig. 2 is a schematic diagram of a transmitter of the system.

Fig. 3 is a schematic diagram of a receiver in the system.

Fig. 4 is a simplified diagrammatic layout of the major components of the complete system.

PREFERRED EMBODIMENT OF THE INVENTION

While the digital communications system of the invention is susceptible to numerous physical embodiments depending on the environment and requirements of use, most installations can be made easily either when new installations are constructed or by simply retrofitting existing fixtures for the sake of improving safety.

Description of Fig. 1: The transmitter has two power supplies; one powers the LED array the other powers the microcontroller.

Concept:
To utilize LED based technology to digitally communicate between runway/taxiway fixtures and aircraft/or ground vehicles located on active runways and taxiways. This communication link would provide SMGCS (surface movement guidance and control system) capabilities to the Air Traffic and Ground Control personnel. The link between the LED based fixtures and the ATC/Ground control could be technologies such as powerline communication, wireless communication, fiber, infrared or other existing technologies. The ultimate goal is to provide "guidance" to individual aircraft and ground vehicles for safe movement about an airport in regards to the surface movement guidance control requirements.

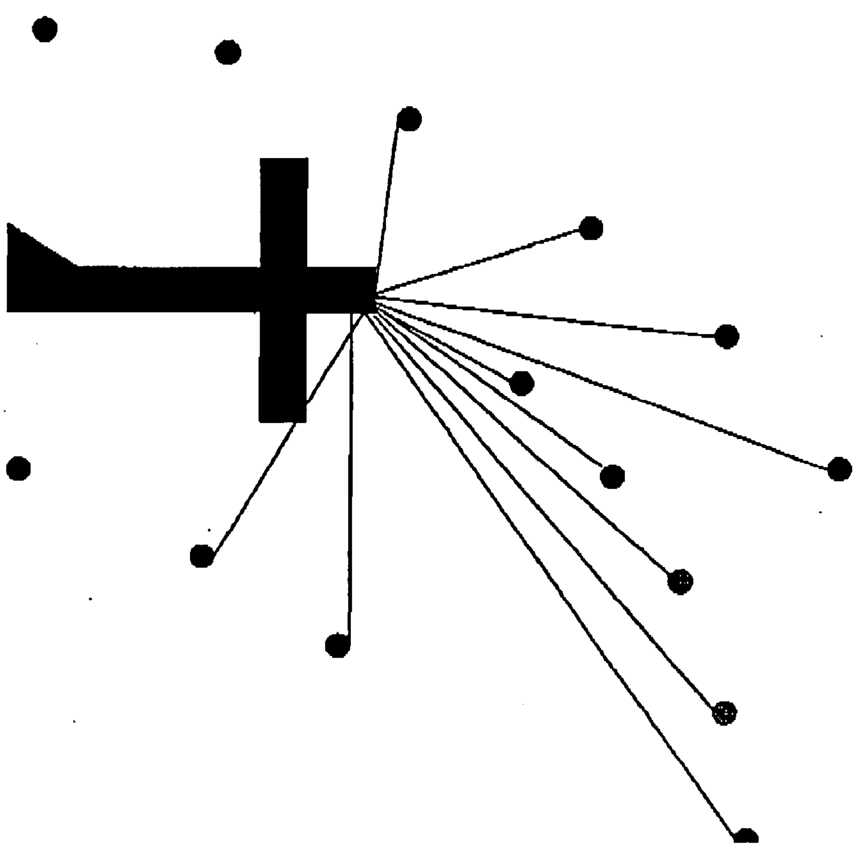
Objective: To provide positive location identification and individual control of aircraft and ground vehicles.

L852 Taxiway Centerline
Receiver/Transmitter

L861T Taxiway Edge
Receiver/Transmitter

Digital Communication Signal link

Receiver



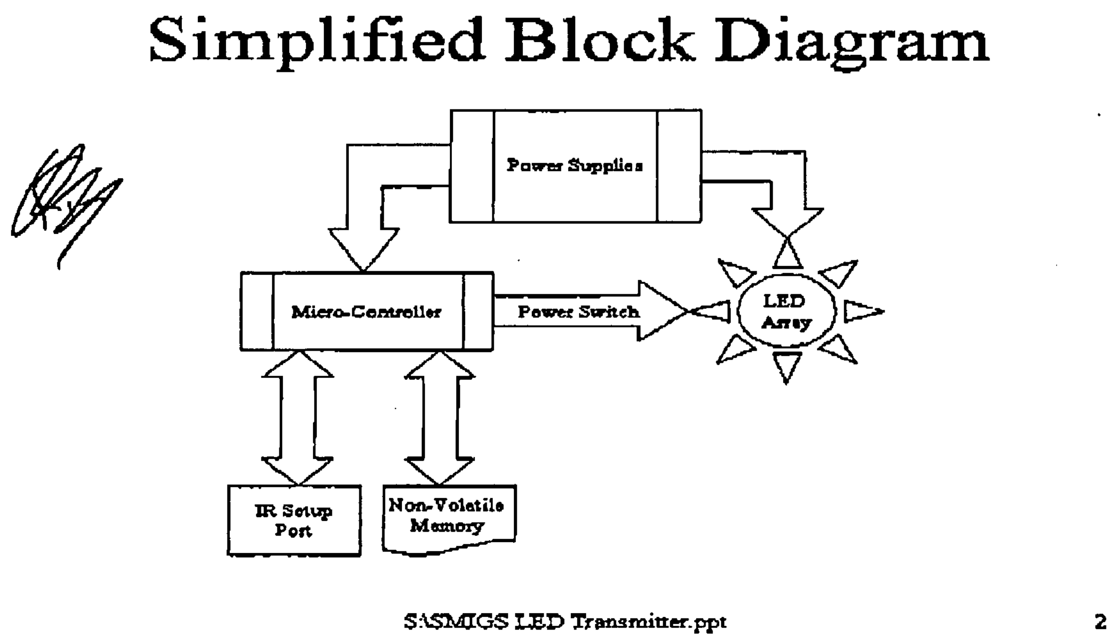


Figure 1. Transmitter Block Diagram

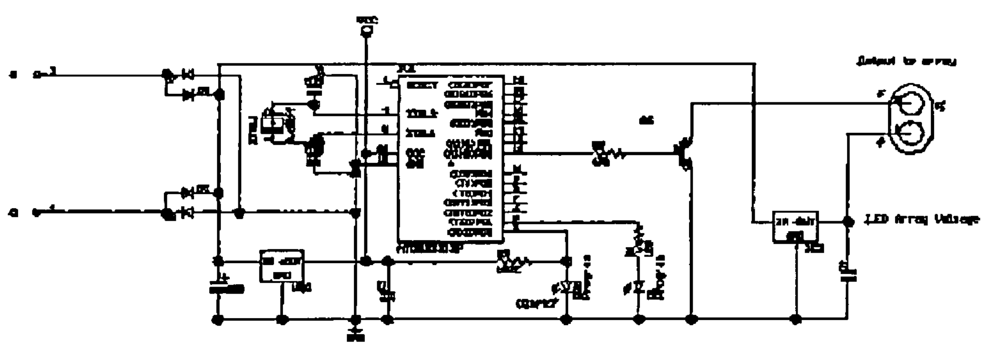
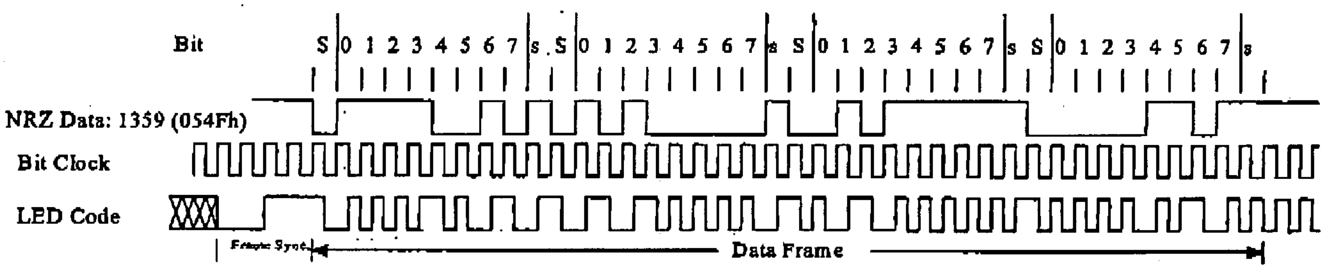


Figure 2. Transmitter Schematic

Data Encoding Example



- Top Time Line
  - Represents a data stream as transmitted from any standard asynchronous UART.
  - Data framed as 1 Start bit, 8 data bits, 1 stop bit
  - Data sent least significant bit first
- Middle Time Line
  - A clock signal used to convert the NRZ data stream to the Manchester Coded data stream as shown in the bottom time line.
  - The bit clock must always be aligned with the start of the frame sync.. Both signals start Low.
- Bottom Time Line
  - Power Switch control signal as a Manchester Encoded data stream representing the NRZ data from the Top Time Line.
  - The "Frame Sync" sequence is used to simplify data reception. It provides the receiving devices a unique, distinguishable signal to be used for proper bit clock alignment.
- Byte Framing
  - 4 bytes total are sent per frame. The ID code followed by it's complement (redundancy for error checking).
  - Each of the two multi-byte numbers are sent little endian.

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Figure 3. Data Encoding Example

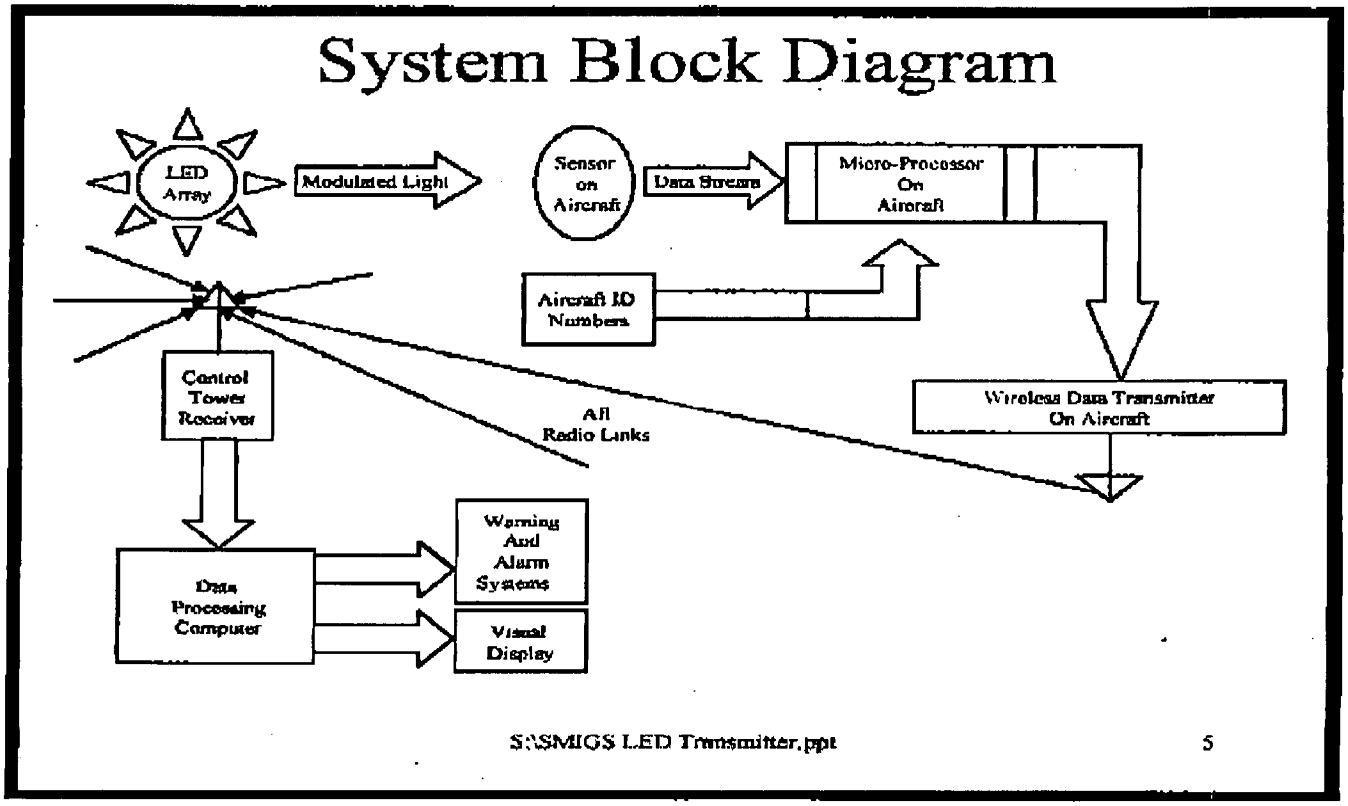

Figure 4. System block Diagram